

VII. *On the parallax of  $\alpha$  Lyræ.* By JOHN POND, Esq.

*Astronomer Royal, F. R. S.*

Read November 14, 1822.

MY former experiments with a fixed telescope upon  $\alpha$  Cygni have always appeared to me so decisive, as to render hopeless any farther attempt to discover its parallax ; but respecting that of  $\alpha$  Lyræ, my observations with the mural circle were not equally satisfactory ; for among the observations of this star we may find occasional discordances that admit of being interpreted in favour of parallax. And although I have been inclined myself to attribute these irregularities to other causes, yet their existence made it desirable to institute new experiments. The method with a fixed telescope, which I had contrived for  $\alpha$  Cygni, could not here, I found, be applied successfully ; there being no star of nearly the same altitude but opposite in right ascension sufficiently bright to be observed throughout the year, a circumstance quite essential to that mode of observation. I have employed therefore the mural circle to investigate, 1st, the difference of parallax between  $\gamma$  Draconis and  $\alpha$  Lyræ : 2dly, the absolute parallax of the latter star ; the Dublin observations indicating, it may be remembered, that the parallax of  $\gamma$  Draconis is insensible, but that of  $\alpha$  Lyræ a very perceptible quantity. The processes employed in these two investigations being very different, I shall consider each of them separately.

*On the difference of parallax between  $\gamma$  Draconis and  $\alpha$  Lyræ.*

It is impossible to conceive a more simple process than that of determining with the mural circle the difference of polar distance between these stars. From their proximity in right ascension, the operation is the same as that of measuring the angular distance of two terrestrial objects, about  $12^\circ$  asunder, with a theodolite surrounded by six microscopes: for the mural circle, in principle, exactly resembles a vertical theodolite; with this difference, that its microscopes, instead of being placed on a frame-work of brass, are securely fixed on a stone pier. Now I find that the angular distance thus measured in winter does not differ one-tenth of a second from the same angular distance measured in summer; and therefore, that the difference of parallax between the two stars is absolutely a quantity too small to be measured. In this investigation, it is to be considered that any constant error in the determination of the absolute polar distances has nothing to do with the question, it being the difference only of those distances at opposite seasons that is required. To render all errors throughout the whole course of observation as constant as possible, the telescope remained fixed to the same part of the limb of the instrument, and the utmost pains were taken to reduce the temperature in the Observatory to that of the outer air; the difference throughout the year not exceeding one degree. The winter of 1821-1822 was extremely favourable for astronomical observation; there were an unusual number of fine nights, and the weather was so mild and uniform, that we were enabled to equalize the temperature, so as to make it of no importance whether the observations were

computed by the outer or inner thermometer ; and it is to this circumstance, in a great measure, that I attribute the perfect coincidence between the observations at different seasons.

It has been objected, however, that perhaps some unexpected effect of temperature deranges the instrument by the exact quantity of the difference of parallax attributed to these stars by Dr. BRINKLEY ; if we suppose a derangement from temperature so considerable as to give a sensible error, even after being diminished by the effect of six microscopes, we should expect the error to be much greater when the experiment is tried with two microscopes only ; for to suppose the contrary, would be to deny the tendency of six microscopes to correct the errors of two. Now I find the same difference of polar distance whether I employ two microscopes or six ; temperature, therefore, cannot materially have vitiated the results by causing derangement in the form of the instrument.

In the whole of the above process I do not see one objectionable point, and if called upon to invent an instrument for this particular experiment, I could not devise one more perfect in principle than the mural circle.

Whoever will compare the above simple process with the more complicated one necessarily employed in using an instrument with two microscopes, turning freely in azimuth, will not hesitate, I think, in deciding upon which of the two instruments temperature is likely to produce the greatest error.

*On the absolute parallax of  $\alpha$  Lyræ.*

The preceding observations only indicate that  $\gamma$  Draconis

and  $\alpha$  Lyræ have the same parallax, or that their difference of parallax is zero ; but they have no tendency to show what is the actual magnitude of the parallax that the two stars have in common. If indeed we admit it to be proved, by the observations of BRADLEY, and the more recent ones of Dr. BRINKLEY, that the parallax of  $\gamma$  Draconis is insensible, we may then infer from the observed difference what is the parallax of the other star. But the method of investigation that we are now about to consider, does not depend on such an admission.

Having successfully adopted the method of observing by reflection, I was desirous of employing it in a series of observations upon  $\alpha$  Lyræ, with a view to determine this question. This series began on the 1st of July, 1822, and has been continued to the present time.\* Although this period embraces only half the interval in which the greatest change or double parallax is affected, a circumstance which at first may appear very disadvantageous, yet that is more than compensated, in my opinion, by the number of observations, and by a uniformity of temperature, such as never can be expected in the extreme seasons of winter and summer.

In observations of this nature the effects of temperature upon the instrument itself, and the uncertain refractions of the ray of light when brought into the lower part of the room, may produce errors of no inconsiderable magnitude, with reference to a question of so much nicety as the present.

I can show however in the present as in the former process, that no error from temperature, affecting the instrument, has

\* Since the date of this paper, the observations have been continued throughout the winter, and the results will be found in the subjoined Table.

introduced itself into this series of observations; for I obtain the same result from the readings with two microscopes as from those made with six.

In the case of two microscopes, the angular distance is measured upon two arcs only. Now it cannot be for a moment contended that an error from temperature, so great as not to be corrected by six microscopes, will not be much exaggerated by employing only two. The errors then, if any, must arise from the effects of temperature on refraction, and not from the changes it occasions in the instrument. But from the season which I have chosen for this investigation, and from the care that has been taken to equalize the temperature, the errors arising from the latter cause must be almost insensible. My observations, thus conducted, indicate in the most decided manner, that the parallax of  $\alpha$  Lyræ cannot exceed a very small fraction of a second. The advantages and disadvantages of the Dublin and Greenwich methods are in this process much more nearly balanced than in the former. The Dublin instrument has the great advantage of determining the zenith distance in the course of a few minutes, whereas at Greenwich twenty-four hours at least, and frequently several days elapse, before a complete observation of the double altitude can be obtained by the method of reflection. This disadvantage attending the Greenwich method could only be remedied by employing two mural circles for observing a star on the same night, both by direct vision and by reflection.

I have now to consider that argument on which the greatest reliance in favour of parallax has been placed, namely, that founded on the actual determination of the solar equation from the observations made with the Dublin instrument.

This argument may, I think, be thus stated. By a series

of observations made with a given instrument two equations have been disengaged, previously considered as unknown in amount, but known only as to the law of their variation. Of these one is much smaller than the other. Hence it is inferred, that as the instrument has faithfully disengaged the smaller equation (respecting which there is no dispute), it must be admitted with equal fidelity to have disengaged the larger, which might be supposed the easier operation of the two. This reasoning is strictly logical, as proving the disengagement of two equations, but it by no means proves the larger equation to be caused by parallax. The larger equation here to be disengaged is after all so small, that it is impossible, in different points of its period, to show that the law assumed coincides with observation; it is only a rude agreement at the points of the greatest and least variation that can be demonstrated. The disengagement of the larger equation only proves therefore the existence of some regularly recurring cause, acting with greatest effect at the extreme seasons.

The reason, I conceive, why Dr. BRINKLEY does not find parallax in  $\gamma$  Draconis is, that with respect to the zenith point, his instrument, like every one of a similar construction, is a perfect instrument. No portion of the arc is employed, nor can temperature here occasion any errors by its changes. As the star to be examined recedes from the zenith, the instrument becomes less and less perfect; and he finds a small parallax in  $\alpha$  Cygni, a larger in  $\alpha$  Lyræ, and oftentimes a still larger in stars more remote from the zenith. An additional reason for suspecting that the discordances observed arise from temperature is this: the greatest supposed parallax is found in those stars whose maximum and minimum of parallax would fall in the ex-

treme seasons, and it is not at all improbable that irregular refraction, arising from the unequal state of the temperature within and without the Observatory, may have had a considerable share in occasioning the Dublin discordances, combined, perhaps, with the effect of the changes of temperature upon the instrument itself. It is a circumstance not hitherto sufficiently noticed by astronomers, that there are many cases where the smallest disturbing cause will produce an error quadruple of its own amount ; and consequently, that the greatest error to which we are liable from such a cause at any one observation will be only one-fourth of the difference that we can detect between the most discordant of them. Of such a nature are those disturbances which, like refraction for instance, introduce errors, both positive and negative, into the determination of either extremity of the arc that measures the distance between two stars.

By a singular combination of circumstances, not probable certainly when considered *a priori*, but by no means impossible, the variation caused by change of temperature may follow an annual law so little differing from that of parallax, as to bring out the assumed parallax, and to leave the solar nutation disengaged.

Notwithstanding the importance of these investigations to the history of astronomy, and to our forming a correct notion of the system of the universe, yet our decision ultimately turns upon so very small a quantity, that our having reduced the enquiry to these narrow limits, rather tends to show the perfection of each instrument than the defect of either.

On former occasions I considered the question of parallax in the particular case of  $\alpha$  Lyræ as undecided, and as perfectly open to future investigation ; but the observations of the present year

have produced, on my mind, a conviction approaching to moral certainty. The history of annual parallax appears to me to be this : in proportion as instruments have been imperfect in their construction, they have misled observers into the belief of the existence of sensible parallax. This has happened in Italy to astronomers of the very first reputation. The Dublin instrument is superior to any of a similar construction on the Continent ; and accordingly, it shows a much less parallax than the Italian astronomers imagined they had detected. Conceiving that I have established, beyond a doubt, that the Greenwich instrument approaches still nearer to perfection, I can come to no other conclusion than that this is the reason why it discovers no parallax at all.

TABLE I.

|    | Names of Stars.    | Predicted<br>N. P. D.<br>1823. |    |       | Observed<br>N. P. D.<br>1823. |    |      | Diff.<br>South. |     |
|----|--------------------|--------------------------------|----|-------|-------------------------------|----|------|-----------------|-----|
|    |                    | °                              | '  | "     | °                             | '  | "    | "               |     |
| 1  | Polaris            |                                |    |       |                               |    |      |                 |     |
| 2  | $\beta$ Urs. Min.  | 15                             | 7  | 16,38 | 15                            | 7  | 15,7 | —0,7            |     |
| 3  | $\beta$ Cephei     | 20                             | 12 | 53,78 | 20                            | 12 | 54,1 | +0,3            |     |
| 4  | $\alpha$ Urs. Maj. | 27                             | 17 | 44,16 | 27                            | 17 | 43,6 | —0,6            |     |
| 5  | $\alpha$ Cephei    | 28                             | 9  | 42,20 | 28                            | 9  | 42,8 | +0,6            |     |
| 6  | $\alpha$ Cassiop.  | 34                             | 26 | 4,23  | 34                            | 26 | 5,8  | +1,6            | } 1 |
| 7  | $\gamma$ Urs. Maj. | 35                             | 19 | 15,18 | 35                            | 19 | 14,8 | —0,4            |     |
| 8  | $\gamma$ Draconis  | 38                             | 29 | 10,31 | 38                            | 29 | 10,5 | +0,2            |     |
| 9  | $\eta$ Urs. Maj.   | 39                             | 47 | 59,55 | 39                            | 47 | 59,6 | —0,1            |     |
| 10 | $\alpha$ Persei    | 40                             | 46 | 38,34 | 40                            | 46 | 39,0 | +0,7            |     |
| 11 | Capella            | 44                             | 11 | 35,11 | 44                            | 11 | 36,9 | +1,8            |     |
| 12 | $\alpha$ Cygni     | 45                             | 20 | 50,80 | 45                            | 20 | 52,4 | +1,6            |     |
| 13 | $\alpha$ Lyrae     | 51                             | 22 | 30,37 | 51                            | 22 | 31,2 | +0,9            |     |
| 14 | Castor             | 57                             | 43 | 58,08 | 57                            | 43 | 59,1 | +1,0            |     |
| 15 | Pollux             | 61                             | 33 | 16,76 | 61                            | 33 | 17,0 | +0,3            |     |
| 16 | $\beta$ Tauri      | 61                             | 33 | 5,74  | 61                            | 33 | 6,7  | +1,0            |     |
| 17 | $\alpha$ Androm.   | 61                             | 53 | 10,75 | 61                            | 53 | 12,4 | +1,7            |     |
| 18 | $\alpha$ Cor. Bor. | 62                             | 41 | 0,07  | 62                            | 41 | 0,6  | +0,5            |     |
| 19 | $\alpha$ Arietis   | 67                             | 22 | 42,60 | 67                            | 22 | 44,4 | +1,8            | } 2 |
| 20 | Arcturus           | 69                             | 53 | 28,83 | 69                            | 53 | 29,2 | +0,4            |     |
| 21 | Aldebaran          | 73                             | 51 | 16,17 | 73                            | 51 | 17,7 | +1,5            |     |
| 22 | $\beta$ Leonis     | 74                             | 26 | 17,73 | 74                            | 26 | 18,1 | +0,4            |     |
| 23 | $\alpha$ Herculis  | 75                             | 23 | 59,70 | 75                            | 24 | 0,0  | +0,3            | } 3 |
| 24 | $\alpha$ Pegasi    | 75                             | 44 | 38,52 | 75                            | 44 | 41,7 | +3,2            |     |
| 25 | Regulus            | 77                             | 10 | 15,00 | 77                            | 10 | 15,4 | +0,4            |     |
| 26 | $\alpha$ Ophiuchi  | 77                             | 18 | 9,74  | 77                            | 18 | 10,6 | +0,9            |     |
| 27 | $\alpha$ Aquilæ    | 81                             | 35 | 28,31 | 81                            | 35 | 29,4 | +1,1            | } 4 |
| 28 | $\alpha$ Orionis   | 82                             | 38 | 2,11  | 82                            | 38 | 4,2  | +2,1            |     |
| 29 | $\alpha$ Serpentis | 84                             | 0  | 36,52 | 84                            | 0  | 36,6 | +0,1            |     |
| 30 | Procyon            | 84                             | 19 | 40,75 | 84                            | 19 | 43,2 | +2,5            |     |
| 31 | $\alpha$ Ceti      | 86                             | 36 | 34,86 | 86                            | 36 | 36,9 | +2,1            |     |
| 32 | $\alpha$ Aquarii   | 91                             | 10 | 28,85 | 91                            | 10 | 31,3 | +2,5            |     |
| 33 | $\alpha$ Hydræ     | 97                             | 53 | 43,20 | 97                            | 53 | 44,5 | +1,3            |     |
| 34 | Rigel              | 98                             | 24 | 46,44 | 98                            | 24 | 48,5 | +2,0            | } 5 |
| 35 | Spica Virg.        | 100                            | 14 | 0,73  | 100                           | 14 | 0,7  | 0,0             |     |
| 36 | Sirius             | 106                            | 28 | 45,35 | 106                           | 28 | 48,9 | +3,5            |     |
| 37 | Antares            | 116                            | 1  | 42,50 | 116                           | 1  | 44,1 | +1,6            |     |

| TABLE II. |                     |                                |                               |                 |
|-----------|---------------------|--------------------------------|-------------------------------|-----------------|
|           | Names of Stars.     | Predicted<br>N. P. D.<br>1823. | Observed<br>N. P. D.<br>1823. | Diff.<br>South. |
| 1         | $\alpha$ Cassiopeia | 34 26 4,23                     | 34 26 5,8                     | + 1,6           |
| 2         | Polaris             |                                |                               |                 |
| 3         | $\alpha$ Arietis    | 67 22 42,60                    | 67 22 44,4                    | + 1,8           |
| 4         | $\alpha$ Ceti       | 86 36 34,86                    | 86 36 36,9                    | + 2,0           |
| 5         | $\alpha$ Persei     | 40 46 38,34                    | 40 46 39,0                    | + 0,7           |
| 6         | Aldebaran           | 73 51 16,17                    | 73 51 17,7                    | + 1,5           |
| 7         | Capella             | 44 11 35,11                    | 44 11 36,9                    | + 1,8           |
| 8         | Rigel               | 98 24 46,44                    | 98 24 48,5                    | + 2,0           |
| 9         | $\beta$ Tauri       | 61 33 5,74                     | 61 33 6,5                     | + 0,8           |
| 10        | $\alpha$ Orionis    | 82 38 2,11                     | 82 38 4,2                     | + 2,1           |
| 11        | Sirius              | 106 28 45,35                   | 106 28 48,9                   | + 3,5           |
| 12        | Castor              | 57 43 58,08                    | 57 43 59,1                    | + 1,0           |
| 13        | Procyon             | 84 19 40,75                    | 84 19 43,2                    | + 2,5           |
| 14        | Pollux              | 61 33 16,76                    | 61 33 17,0                    | + 0,2           |
| 15        | $\alpha$ Hydræ      | 97 53 43,20                    | 97 53 44,5                    | + 1,3           |
| 16        | Regulus             | 77 10 15,00                    | 77 10 15,6                    | + 0,4           |
| 17        | $\alpha$ Urs. Maj.  | 27 17 44,16                    | 27 17 43,4                    | - 0,6           |
| 18        | $\beta$ Leonis      | 74 26 17,73                    | 74 26 18,1                    | + 0,4           |
| 19        | $\gamma$ Urs. Maj.  | 35 19 15,18                    | 35 19 14,4                    | - 0,4           |
| 20        | Spica Virg.         | 100 14 0,73                    | 100 14 0,7                    | 0,0             |
| 21        | $\eta$ Urs. Maj.    | 39 47 59,60                    | 39 47 59,5                    | - 0,1           |
| 22        | Arcturus            | 69 53 28,83                    | 69 53 29,2                    | + 0,4           |
| 23        | $\beta$ Urs. Min.   | 15 7 16,38                     | 15 7 15,6                     | - 0,8           |
| 24        | $\alpha$ Cor. Bor.  | 62 41 0,07                     | 62 41 0,6                     | + 0,5           |
| 25        | $\alpha$ Serpentis  | 84 0 36,52                     | 84 0 36,6                     | + 0,1           |
| 26        | Antares             | 116 1 42,50                    | 116 1 44,1                    | + 1,6           |
| 27        | $\alpha$ Herculis   | 75 23 59,70                    | 75 24 0,0                     | + 0,3           |
| 28        | $\alpha$ Ophiuchi   | 77 18 9,74                     | 77 18 10,6                    | + 0,9           |
| 29        | $\gamma$ Draconis   | 38 29 10,31                    | 38 29 10,5                    | + 0,2           |
| 30        | $\alpha$ Lyrae      | 51 22 30,37                    | 51 22 30,2                    | + 0,9           |
| 31        | $\alpha$ Aquilæ     | 81 35 28,31                    | 81 35 29,4                    | + 1,1           |
| 32        | $\alpha$ Cygni      | 45 20 50,80                    | 45 20 52,4                    | + 1,6           |
| 33        | $\alpha$ Cephei     | 28 9 42,20                     | 28 9 42,9                     | + 0,7           |
| 34        | $\beta$ Cephei      | 20 12 53,78                    | 20 12 54,1                    | + 0,3           |
| 35        | $\alpha$ Aquarii    | 91 10 28,85                    | 91 10 31,3                    | + 2,5           |
| 36        | $\alpha$ Pegasi     | 75 44 38,52                    | 75 44 41,7                    | + 3,2           |
| 37        | $\alpha$ Androm.    | 61 53 10,75                    | 61 53 12,4                    | + 1,7           |

TABLE III.

|    | Names of Stars.    | Interpolated<br>N. P. D. 1813.<br>from<br>1756 & 1823. | Difference. |            |
|----|--------------------|--------------------------------------------------------|-------------|------------|
|    |                    |                                                        | Dublin.     | Greenwich. |
| 1  | Polaris            | 0   '   "                                              | "           | "          |
| 2  | $\beta$ Ursæ Min.  | 15 4 48,2                                              | — 1,1       | — 0,8      |
| 3  | $\beta$ Cephei     | 20 15 31,0                                             | + 0,1       | + 0,4      |
| 4  | $\alpha$ Ursæ Maj. | 27 14 31,0                                             | — 0,7       | — 0,6      |
| 5  | $\alpha$ Cephei    | 28 12 13,6                                             | + 0,3       | + 1,0      |
| 6  | $\alpha$ Cassiop.  | 34 29 24,1                                             | + 2,2       | + 1,3      |
| 7  | $\gamma$ Ursæ Maj. | 35 15 54,8                                             | — 0,7       | — 0,5      |
| 8  | $\gamma$ Draconis  | 38 29 3,7                                              | + 0,7       | + 0,1      |
| 9  | $\eta$ Ursæ Maj.   | 39 44 58,1                                             | + 0,5       | + 0,2      |
| 10 | $\alpha$ Persei    | 40 48 53,2                                             | + 2,6       | + 0,7      |
| 11 | Capella            | 44 12 22,0                                             | + 2,1       | + 1,5      |
| 12 | $\alpha$ Cygni     | 45 22 58,4                                             | + 0,9       | + 1,3      |
| 13 | $\alpha$ Lyræ      | 51 23 1,2                                              | + 1,3       | + 0,6      |
| 14 | Castor             | 57 42 47,9                                             | + 1,3       | + 1,1      |
| 15 | Pollux             | 61 31 57,1                                             | + 2,0       | + 0,6      |
| 16 | $\beta$ Tauri      | 61 33 44,8                                             | + 1,6       | + 1,0      |
| 17 | $\alpha$ Androm.   | 61 56 31,6                                             | + 2,3       | + 1,3      |
| 18 | $\alpha$ Cor. Bor. | 62 38 55,9                                             | + 1,5       | + 0,4      |
| 19 | $\alpha$ Arietis   | 67 25 38,4                                             | + 2,7       | + 1,8      |
| 20 | Arcturus           | 69 50 19,3                                             | + 1,1       | + 0,2      |
| 21 | Aldebaran          | 73 52 36,7                                             | + 1,9       | + 1,4      |
| 22 | $\beta$ Leonis     | 74 22 57,5                                             | + 2,3       | + 0,2      |
| 23 | $\alpha$ Herculis  | 75 23 14,3                                             | + 1,1       | + 0,3      |
| 24 | $\alpha$ Pegasi    | 75 47 54,2                                             | + 2,5       | + 2,5      |
| 25 | Regulus            | 77 7 23,0                                              | + 1,2       | + 0,3      |
| 26 | $\alpha$ Ophiuchi  | 77 17 39,6                                             | + 0,4       | + 0,6      |
| 27 | $\alpha$ Aquilæ    | 81 36 59,7                                             | + 1,2       | + 0,8      |
| 28 | $\alpha$ Orionis   | 82 38 17,4                                             | + 2,8       | + 1,7      |
| 29 | $\alpha$ Serpentis | 82 58 39,4                                             | + 2,0       | + 0,1      |
| 30 | Procyon            | 84 18 16,7                                             | + 2,8       | + 2,3      |
| 31 | $\alpha$ Ceti      | 86 39 2,5                                              | + 1,9       | + 1,7      |
| 32 | $\alpha$ Aquarii   | 91 13 24,0                                             | + 3,8       | + 2,4      |
| 33 | $\alpha$ Hydræ     | 97 51 12,4                                             | + 3,0       | + 1,1      |
| 34 | Rigel              | 98 25 35,5                                             | + 2,8       | + 1,7      |
| 35 | Spica Virg.        | 100 10 51,3                                            | + 1,7       | + 0,5      |
| 36 | Sirius.            | 106 28 4,2                                             | + 1,9       | + 2,7      |

TABLE IV.

|    | Names of Stars.     | N. P. D.<br>1822.<br>I. |           | No. of<br>Obs. | N. P. D.<br>1822.<br>II. |       | No. of<br>Obs. |       | N. P. D.<br>1822.<br>III. |       | No. of<br>Obs. |       | N. P. D.<br>1822.<br>IV. |           | No. of<br>Obs. |
|----|---------------------|-------------------------|-----------|----------------|--------------------------|-------|----------------|-------|---------------------------|-------|----------------|-------|--------------------------|-----------|----------------|
|    |                     | D.                      | R.        |                | D.                       | R.    | D.             | R.    | D.                        | R.    |                |       |                          |           |                |
| 1  | Polaris             | 0                       | 1 38 27,0 | 300            | 0                        | 1 "   |                |       | 0                         | 1 "   |                |       | 0                        | 1 38 26,8 | 300            |
| 2  | $\beta$ Ursæ Min.   | 15                      | 7 0,8     | 91             | 15                       | 7 1,0 | 22 18          | 21 18 | 15                        | 7 0,5 | 22 18          | 21 18 | 15                       | 7 0,4     | 92             |
| 3  | $\beta$ Cephei      | 20                      | 13 9,7    | 44             |                          | 9,7   |                |       |                           | 9,8   |                |       |                          | 9,2       | 46             |
| 4  | $\alpha$ Ursæ Maj.  | 27                      | 17 24,6   | 53             |                          | 24,4  | 14 13          |       |                           | 23,9  | 12 10          |       |                          | 24,1      | 53             |
| 5  | $\alpha$ Cephei     | 28                      | 9 57,5    | 37             |                          | 57,9  | 25 20          |       |                           | 58,1  | 25 20          |       |                          | 57,7      | 41             |
| 6  | $\alpha$ Cassiopeiæ | 34                      | 26 25,6   | 51             |                          | 26,0  | 12 8           |       |                           | 25,9  | 12 8           |       |                          | 25,3      | 56             |
| 7  | $\gamma$ Ursæ Maj.  | 35                      | 18 54,8   | 45             |                          |       |                |       |                           |       |                |       |                          | 55,0      | 45             |
| 8  | $\gamma$ Draconis   | 38                      | 29 9,8    | 120            |                          |       |                |       |                           |       |                |       |                          | 9,7       | 120            |
| 9  | $\eta$ Ursæ Maj.    | 39                      | 47 41,5   | 95             |                          |       |                |       |                           |       |                |       |                          | 40,7      | 95             |
| 10 | $\alpha$ Persei     | 40                      | 46 52,5   | 48             |                          |       |                |       |                           |       |                |       |                          | 53,1      | 51             |
| 31 | Capella             | 44                      | 11 41,4   | 75             |                          | 41,4  | 25 20          |       |                           | 41,5  | 25 20          |       |                          | 41,6      | 75             |
| 12 | $\alpha$ Cygni      | 45                      | 21 5,0    | 80             |                          | 5,1   | 40 40          |       |                           | 5,4   | 40 40          |       |                          | 5,1       | 84             |
| 13 | $\alpha$ Lyrae      | 51                      | 22 34,5   | 87             |                          | 34,0  | 60 60          |       |                           | 34,2  | 60 60          |       |                          | 34,8      | 89             |
| 14 | Castor              | 57                      | 43 52,2   | 60             |                          | 52,0  | 20 18          |       |                           | 52,3  | 20 18          |       |                          | 52,2      | 52             |
| 15 | Pollux              | 61                      | 33 9,1    | 60             |                          | 8,8   | 15 15          |       |                           | 8,8   | 15 15          |       |                          | 8,9       | 50             |
| 16 | $\beta$ Tauri       | 61                      | 33 10,5   | 50             |                          | 10,3  | 16 16          |       |                           | 10,5  | 16 16          |       |                          | 10,2      | 46             |
| 17 | $\alpha$ Androm.    | 61                      | 53 32,6   | 30             |                          | 32,6  | 12 10          |       |                           | 32,4  | 12 10          |       |                          | 32,4      | 37             |
| 18 | $\alpha$ Cor. Bor.  | 62                      | 40 48,3   | 26             |                          | 48,1  | 16 16          |       |                           | 48,1  | 22 18          |       |                          | 48,3      | 32             |
| 19 | $\alpha$ Arietis    | 67                      | 23 1,6    | 44             |                          | 1,8   | 24 17          |       |                           | 2,0   | 24 17          |       |                          | 1,6       | 49             |
| 20 | Arcturus            | 69                      | 53 10,2   | 84             |                          | 10,2  | 21 22          |       |                           | 10,5  | 21 22          |       |                          | 10,0      | 84             |
| 21 | Aldebaran           | 73                      | 51 25,6   | 58             |                          | 25,5  | 20 16          |       |                           | 25,6  | 20 16          |       |                          | 25,4      | 66             |
| 22 | $\beta$ Leonis      | 74                      | 25 58,5   | 16             |                          | 58,1  | 16 16          |       |                           | 58,3  | 16 16          |       |                          | 58,7      | 16             |
| 23 | $\alpha$ Herculis   | 75                      | 23 55,5   | 17             |                          | 55,6  | 10 13          |       |                           | 56,3  | 21 24          |       |                          | 55,7      | 31             |
| 24 | $\alpha$ Pegasi     | 75                      | 45 1,0    | 30             |                          | 1,1   | 24 20          |       |                           | 1,4   | 24 20          |       |                          | 1,4       | 34             |
| 25 | Regulus             | 77                      | 9 57,8    | 54             |                          | 58,5  | 33 25          |       |                           | 59,1  | 33 22          |       |                          | 58,7      | 54             |
| 26 | $\alpha$ Ophiuchi   | 77                      | 18 7,6    | 20             |                          | 7,8   | 10 12          |       |                           | 7,6   | 21 25          |       |                          | 7,3       | 34             |
| 27 | $\alpha$ Aquilæ     | 81                      | 35 38,7   | 70             |                          | 38,6  | 44 42          |       |                           | 38,9  | 44 42          |       |                          | 39,0      | 86             |
| 28 | $\alpha$ Orionis    | 82                      | 38 5,7    | 48             |                          | 5,6   | 12 12          |       |                           | 6,1   | 14 14          |       |                          | 5,7       | 54             |
| 29 | $\alpha$ Serpentis  | 83                      | 0 25,3    | 31             |                          | 24,7  | 17 14          |       |                           | 25,4  | 17 14          |       |                          | 25,5      | 37             |
| 30 | Procyon             | 84                      | 19 34,8   | 57             |                          | 34,6  | 10 7           |       |                           | 34,9  | 10 7           |       |                          | 34,5      | 63             |
| 31 | $\alpha$ Ceti       | 86                      | 36 51,4   | 46             |                          |       |                |       |                           |       |                |       |                          | 51,2      | 46             |
| 32 | $\alpha$ Aquarii    | 91                      | 10 48,6   | 40             |                          | 48,7  | 26 15          |       |                           | 48,9  | 27 15          |       |                          | 49,0      | 40             |
| 33 | $\alpha$ Hydræ      | 97                      | 53 29,2   | 18             |                          | 29,4  | 16 12          |       |                           | 29,4  | 16 12          |       |                          | 30,0      | 18             |
| 34 | Rigel               | 98                      | 24 53,3   | 11             |                          |       |                |       |                           |       |                |       |                          | 53,8      | 19             |
| 35 | Spica Virg.         | 100                     | 13 41,6   | 22             |                          | 41,8  | 22 24          |       |                           | 41,2  | 22 24          |       |                          | 41,6      | 21             |
| 36 | Sirius.             | 106                     | 28 44,4   | 75             |                          | 44,3  | 7 7            |       |                           | 43,9  | 7 7            |       |                          | 44,5      | 75             |
| 37 | Antares.            | 116                     | 1 35,5    | 5              |                          | 35,4  | 5 5            |       |                           | 35,6  | 5 5            |       |                          | 36,0      | 5              |

No. I, is computed in the usual manner by direct measurement from the Pole.

No. II, by the angular distance of the stars from their reflected images in an artificial horizon, co-latitude assumed  $38^{\circ} 31' 21''$ .

No. III, computed in the same manner as No. II, but from observations with two microscopes only.

No. IV, computed from observations with two microscopes in the same manner as No. I.

TABLE V.

|    |                    | Error of<br>Catalogue.<br>I. | Error of<br>Catalogue.<br>II. | Error of<br>Catalogue.<br>III. | Error of<br>Catalogue.<br>IV. |                                                                                                |
|----|--------------------|------------------------------|-------------------------------|--------------------------------|-------------------------------|------------------------------------------------------------------------------------------------|
| 1  | Polaris            | "                            | "                             | "                              | "                             |                                                                                                |
| 2  | $\beta$ Ursæ Min.  | 0,0                          | + 0, 2                        | - 0, 3                         | - 0, 4                        |                                                                                                |
| 3  | $\beta$ Cephei     | 0,0                          | 0, 0                          | + 0, 1                         | - 0, 5                        |                                                                                                |
| 4  | $\alpha$ Ursæ Maj. | + 0, 2                       | - 0, 1                        | - 0, 5                         | - 0, 3                        |                                                                                                |
| 5  | $\alpha$ Cephei    | - 0, 3                       | + 0, 1                        | + 0, 3                         | - 0, 1                        |                                                                                                |
| 6  | $\alpha$ Cassiop.  |                              |                               |                                |                               | This star was found to be too near<br>the zenith to be observed accu-<br>rately by reflection. |
| 7  | $\gamma$ Ursæ Maj. |                              |                               |                                |                               |                                                                                                |
| 8  | $\gamma$ Draconis  |                              |                               |                                |                               |                                                                                                |
| 9  | $\eta$ Ursæ Maj.   |                              |                               |                                |                               |                                                                                                |
| 10 | $\alpha$ Persei    |                              |                               |                                |                               |                                                                                                |
| 11 | Capella            | + 0, 1                       | 0, 0                          | + 0, 1                         | + 0, 3                        |                                                                                                |
| 12 | $\alpha$ Cygni     | - 0, 1                       | 0, 0                          | + 0, 3                         | 0, 0                          |                                                                                                |
| 13 | $\alpha$ Lyrae     | + 0, 3                       | - 0, 2                        | 0, 0                           | + 0, 6                        | Discordant from error of division.                                                             |
| 14 | Castor             | 0, 0                         | + 0, 1                        | + 0, 1                         | 0, 0                          |                                                                                                |
| 15 | Pollux             | + 0, 1                       | - 0, 2                        | - 0, 2                         | - 0, 1                        |                                                                                                |
| 16 | $\beta$ Tauri      | + 0, 1                       | - 0, 1                        | + 0, 2                         | - 0, 2                        |                                                                                                |
| 17 | $\alpha$ Androm.   | + 0, 1                       | + 0, 1                        | - 0, 1                         | - 0, 1                        |                                                                                                |
| 18 | $\alpha$ Cor. Bor. | + 0, 1                       | - 0, 1                        | - 0, 1                         | + 0, 1                        |                                                                                                |
| 19 | $\alpha$ Arietis   | - 0, 1                       | + 0, 1                        | + 0, 3                         | - 0, 1                        |                                                                                                |
| 20 | Arcturus           | 0, 0                         | 0, 0                          | + 0, 3                         | - 0, 2                        |                                                                                                |
| 21 | Aldebaran          | 0, 0                         | - 0, 1                        | + 0, 0                         | - 0, 2                        |                                                                                                |
| 22 | $\beta$ Leonis     | + 0, 2                       | - 0, 2                        | + 0, 0                         | + 0, 4                        |                                                                                                |
| 23 | $\alpha$ Herculis  | - 0, 1                       | 0, 0                          | + 0, 7                         | + 0, 1                        | No. III. discordant from the observ <sup>s</sup> .<br>having been made at different seasons.   |
| 24 | $\alpha$ Pegasi    | 0, 0                         | - 0, 1                        | + 0, 2                         | + 0, 2                        |                                                                                                |
| 25 | Regulus            | - 0, 4                       | + 0, 3                        | + 0, 4                         | + 0, 5                        | This star is reserved for future ex-<br>amination.                                             |
| 26 | $\alpha$ Ophiuchi  | + 0, 2                       | 0, 0                          | + 0, 5                         | + 0, 1                        |                                                                                                |
| 27 | $\alpha$ Aquilæ    | 0, 0                         | - 0, 1                        | + 0, 2                         | + 0, 3                        |                                                                                                |
| 28 | $\alpha$ Orionis   | + 0, 1                       | + 0, 0                        | + 0, 4                         | 0, 0                          |                                                                                                |
| 29 | $\alpha$ Serpentis | + 0, 3                       | - 0, 3                        | + 0, 4                         | + 0, 5                        | Discordant from the different sea-<br>sons of observation, and requiring<br>examination.       |
| 30 | Procyon            | + 0, 2                       | 0, 0                          | + 0, 3                         | - 0, 1                        |                                                                                                |
| 31 | $\alpha$ Ceti      |                              |                               |                                |                               |                                                                                                |
| 32 | $\alpha$ Aquarii   | - 0, 1                       | 0, 0                          | + 0, 3                         | + 0, 4                        |                                                                                                |
| 33 | $\alpha$ Hydræ     | - 0, 1                       | - 0, 0                        | 0, 0                           | + 0, 6                        |                                                                                                |
| 34 | Rigel              |                              |                               |                                |                               |                                                                                                |
| 35 | Spica Viig.        | - 0, 2                       | 0, 0                          | - 0, 6                         | - 0, 2                        |                                                                                                |
| 36 | Sirius.            | + 0, 1                       | 0, 0                          | - 0, 4                         | + 0, 2                        |                                                                                                |
| 37 | Antares.           | 0, 0                         | 0, 0                          | + 0, 1                         | + 0, 5                        |                                                                                                |
|    | Sum of Errors      | 3, 8                         | 2, 3                          | 8, 0                           | 7, 3                          |                                                                                                |
|    | Mean Error         | 0,13                         | 0,08                          | 0,26                           | 0,25                          |                                                                                                |

From the exact coincidence of Catalogue I. and II. it may be inferred that the assumed co-lat.  $38^{\circ} 31' 21''$ , 0 is extremely near the truth.

TABLE VI.

|    |                    | N. P. D.<br>1822.<br>Greenwich. | N. P. D.<br>1822.<br>Dublin. | Difference<br>in 1822. |         | Difference<br>in 1812. |         | Difference<br>between<br>Bessel and<br>Greenwich. |         |
|----|--------------------|---------------------------------|------------------------------|------------------------|---------|------------------------|---------|---------------------------------------------------|---------|
| 1  | Polaris            | 0 38 26,9                       | 26,7                         | — 0,2                  |         |                        |         |                                                   |         |
| 2  | $\beta$ Ursæ Min.  | 15 7 0,8                        | 1,8                          | + 1,0                  |         |                        |         |                                                   |         |
| 3  | $\beta$ Cephei     | 20 13 9,8                       | 9,8                          | 0,0                    |         |                        |         |                                                   |         |
| 4  | $\alpha$ Ursæ Maj. | 27 17 24,3                      | 24,1                         | — 0,2                  | } — 0,6 | — 1,2                  | } — 0,3 |                                                   |         |
| 5  | $\alpha$ Cephei    | 28 9 58,0                       | 57,2                         | — 0,8                  |         | + 0,8                  |         |                                                   |         |
| 6  | $\alpha$ Cassiop.  | 34 26 25,8                      | 23,3                         | — 2,5                  |         | — 0,8                  |         |                                                   |         |
| 7  | $\gamma$ Ursæ Maj. | 35 18 54,4                      | 54,5                         | + 0,1                  |         | + 0,3                  |         |                                                   |         |
| 8  | $\gamma$ Draconis  | 38 29 9,8                       | 8,9                          | + 1,0                  |         | — 0,6                  |         |                                                   |         |
| 9  | $\eta$ Ursæ Maj.   | 39 47 41,6                      | 41,0                         | — 0,6                  | } — 1,3 | — 0,3                  | } — 0,7 |                                                   |         |
| 10 | $\alpha$ Persei    | 40 46 52,5                      |                              | — 1,1                  |         |                        |         |                                                   |         |
| 11 | Capella            | 44 11 41,4                      | 39,8                         | — 1,6                  |         | — 0,6                  |         | + 0,5                                             | } + 1,5 |
| 12 | $\alpha$ Cygni     | 45 21 5,0                       | 3,7                          | — 1,3                  |         | + 0,4                  |         | + 1,8                                             |         |
| 13 | $\alpha$ Lyræ      | 51 22 34,2                      | 32,9                         | — 1,3                  |         | — 0,5                  |         | + 2,2                                             |         |
| 14 | Castor             | 57 43 52,0                      | 50,7                         | — 1,3                  |         | — 0,1                  |         | + 1,3                                             |         |
| 15 | Pollux             | 61 33 9,0                       | 8,2                          | — 0,8                  | } — 1,9 | — 1,2                  | } — 0,8 | + 1,5                                             | } + 2,4 |
| 16 | $\beta$ Tauri      | 61 33 10,4                      | 9,4                          | — 1,0                  |         | — 0,5                  |         | + 1,7                                             |         |
| 17 | $\alpha$ Androm.   | 61 53 32,5                      | 30,9                         | — 1,6                  |         | 0,3                    |         | + 1,0                                             |         |
| 18 | $\alpha$ Cor. Bor. | 62 40 48,2                      | 46,8                         | — 1,4                  |         | — 1,0                  |         | + 2,3                                             |         |
| 19 | $\alpha$ Arietis   | 67 23 1,7                       | 0,2                          | — 1,5                  |         | — 0,7                  |         | + 1,1                                             |         |
| 20 | Arcturus           | 69 53 10,2                      | 9,5                          | — 0,7                  | } — 1,9 | — 0,9                  | } — 0,8 | + 2,3                                             | } + 2,4 |
| 21 | Aldebaran          | 73 51 25,6                      | 24,2                         | — 1,4                  |         | — 0,7                  |         | + 1,4                                             |         |
| 22 | $\beta$ Leonis     | 74 25 58,1                      | 56,6                         | — 1,5                  |         | — 2,0                  |         | + 2,0                                             |         |
| 23 | $\alpha$ Herculis  | 75 23 55,5                      |                              |                        |         |                        |         | + 3,3                                             |         |
| 24 | $\alpha$ Pegasi    | 75 45 1,0                       |                              |                        |         |                        |         | + 1,3                                             |         |
| 25 | Regulus            | 77 9 58,2                       | 58,1                         | — 0,1                  | } — 1,9 | — 0,9                  | } — 0,8 | + 2,8                                             | } + 2,4 |
| 26 | $\alpha$ Ophiuchi  | 77 18 7,4                       | 6,2                          | — 1,4                  |         | 0,0                    |         | + 3,2                                             |         |
| 27 | $\alpha$ Aquilæ    | 81 35 38,5                      | 36,6                         | — 1,9                  |         | — 0,4                  |         | + 2,7                                             |         |
| 28 | $\alpha$ Orionis   | 82 38 5,6                       | 4,0                          | — 1,6                  |         | — 1,1                  |         | + 1,0                                             |         |
| 29 | $\alpha$ Serpentis | 83 0 24,9                       | 23,5                         | — 1,4                  |         | — 1,9                  |         | + 3,7                                             |         |
| 30 | Procyon            | 84 19 34,6                      | 32,9                         | — 1,7                  | } — 2,0 | — 0,5                  | }       | + 2,3                                             | } + 2,4 |
| 31 | $\alpha$ Ceti      | 86 36 51,4                      | 49,5                         | — 1,9                  |         | — 0,1                  |         | + 1,7                                             |         |
| 32 | $\alpha$ Aquarii   | 91 10 48,6                      | 45,7                         | — 2,9                  |         | — 1,7                  |         | + 2,3                                             |         |
| 33 | $\alpha$ Hydræ     | 97 53 29,3                      |                              |                        |         |                        |         | + 2,8                                             |         |
| 34 | Rigel              | 98 24 53,2                      |                              |                        |         |                        |         | + 1,5                                             |         |
| 35 | Spica Virg.        | 100 13 41,8                     | 40,9                         | — 0,9                  |         |                        |         | + 3,8                                             |         |
| 36 | Sirius.            | 106 28 44,3                     | 42,3                         | — 2,0                  |         |                        |         | + 1,7                                             |         |

6.  $\alpha$  Cassiop. I suspect some mistake in the computations of this star; I have therefore in taking the mean, substituted  $\alpha$  Persei for it, which Dr. BRINKLEY was so obliging as to send me a few days since.

25. Regulus. There is probably also some mistake relative to this star.

36. Sirius. By a number of observations made last year at the same period, and computed by the same equations: the two results differ exactly 2". This seems therefore to be the quantity by which the two instruments differ in measuring an angle of 100°.

TABLE VII.

|    |                       | Bradley's refract.<br>N. P. D.<br>1820.<br>Dr. Brinkley. | N. P. D<br>1820.<br>Mr. Bessel. | Difference between<br>Dr. Brinkley and<br>Mr. Bessel. |
|----|-----------------------|----------------------------------------------------------|---------------------------------|-------------------------------------------------------|
| 1  | Polaris               | 0 1 39 5, 6                                              |                                 |                                                       |
| 2  | $\beta$ Ursæ Min.     | 15 6 32, 2                                               |                                 |                                                       |
| 3  | $\beta$ Cephei        | 20 13 41, 0                                              |                                 |                                                       |
| 4  | $\alpha$ Ursæ Maj.    | 27 16 45, 8                                              |                                 |                                                       |
| 5  | $\alpha$ Cephei       | 28 10 27, 3                                              |                                 |                                                       |
| 6  | $\alpha$ Cassiopeiæ   | 34 27 3, 0                                               |                                 |                                                       |
| 7  | $\gamma$ Ursæ Maj.    | 35 18 14, 5                                              |                                 |                                                       |
| 8  | $\gamma$ Draconis     | 38 29 7, 5                                               |                                 |                                                       |
| 9  | $\eta$ Ursæ maj.      | 39 47 4, 8                                               |                                 |                                                       |
| 10 | $\alpha$ Persei       |                                                          | 0 1 50,88                       | 2,1                                                   |
| 11 | Capella               | 44 11 48, 8                                              |                                 |                                                       |
| 12 | $\alpha$ Cygni        | 45 21 28, 9                                              | 31,53                           | 2,6                                                   |
| 13 | $\alpha$ Lyræ         | 51 22 39, 0                                              | 42,23                           | 3,2                                                   |
| 14 | Castor                | 57 43 36, 3                                              | 38,95                           | 2,6                                                   |
| 15 | Pollux                | 61 32 52, 0                                              | 54,46                           | 2,5                                                   |
| 16 | $\beta$ Tauri         | 61 33 16, 9                                              | 19,60                           | 2,7                                                   |
| 17 | $\alpha$ Androm.      | 61 54 10, 7                                              | 13,41                           | 2,7                                                   |
| 18 | $\alpha$ Cor Bor.     | 62 40 21, 9                                              | 25,51                           | 3,7                                                   |
| 19 | $\alpha$ Arietis      | 67 23 34, 7                                              | 37,68                           | 3,0                                                   |
| 20 | Arcturus              | 69 52 31, 5                                              | 34,57                           | 3,0                                                   |
| 21 | Aldebaran             | 73 51 40, 1                                              | 42,84                           | 2,7                                                   |
| 22 | $\beta$ Leonis        | 74 25 16, 5                                              | 19,96                           | 3,5                                                   |
| 23 | $\alpha$ Herculis     |                                                          |                                 |                                                       |
| 24 | $\alpha$ Pegasi       |                                                          |                                 |                                                       |
| 25 | Regulus               | 77 9 23, 5                                               | 26,42                           | 2,9                                                   |
| 26 | $\alpha$ Ophiuchi     | 77 18 0, 0                                               | 4,34                            | 4,3                                                   |
| 27 | $\alpha$ Aquilæ       | 81 35 54, 7                                              | 59,31                           | 4,6                                                   |
| 28 | $\alpha$ Orionis      | 82 36 6, 5                                               | 9,34                            | 2,8                                                   |
| 29 | $\alpha$ Serpentis    | 83 0 0, 0                                                | 5,16                            | 5,2                                                   |
| 30 | Procyon               | 84 19 15, 5                                              | 19,68                           | 4,2                                                   |
| 31 | $\alpha$ Ceti         | 86 37 18, 3                                              | 22,33                           | 5,0                                                   |
| 32 | $\alpha$ Aquarii      | 91 11 20, 5                                              | 25,48                           | 5,0                                                   |
| 33 | $\alpha$ Hydræ        |                                                          | 97 53 1,68                      |                                                       |
| 34 | Rigel                 |                                                          |                                 |                                                       |
| 35 | Spica Virg.           | 100 13 4, 4                                              | 7,69                            | 3,3                                                   |
| 36 | Sirius                | 106 28 33, 1                                             | 37,15                           | 4,0                                                   |
| 37 | Antares.              |                                                          |                                 |                                                       |
|    | $\gamma$ Aquilæ.      | 79 49 1, 6                                               | 6,03                            | 4,4                                                   |
|    | $\beta$               | 84 2 3, 3                                                | 9,16                            | 5,9                                                   |
|    | 1 } $\alpha$ Capri. { | 103 3 19,60                                              | 25,59                           | 6,0                                                   |
|    | 2 } $\alpha$ Capri. { | 103 5 37,03                                              | 43,49                           | 6,5                                                   |
|    | $\gamma$ Pegasi.      | 75 48 59, 3                                              | 49 3,78                         | 4,5                                                   |

TABLE VIII.  
General Catalogue of Stars for the year 1813.

| 1756 & 1813.<br>An. Var.<br>1818. | Number. | Names of Stars.   | R. 1823,    |              |             | Predicted N. P. D.<br>1823. |          |       | Observed N. P. D.<br>1823.<br>Bradley's Refrac-<br>tion. |                |              | Stars<br>observed<br>South. | No. of Observations. |  |  | Interpolated Cata-<br>logue N. P. D.<br>1818.<br>1813 + 1823. |  |  | No. of<br>Observations. |
|-----------------------------------|---------|-------------------|-------------|--------------|-------------|-----------------------------|----------|-------|----------------------------------------------------------|----------------|--------------|-----------------------------|----------------------|--|--|---------------------------------------------------------------|--|--|-------------------------|
|                                   |         |                   | h. m. s.    | ° ' "        | ° ' "       | ° ' "                       | ° ' "    | 1756. | 1812.<br>1813.                                           | 1822.<br>1823. | 1813 + 1823. |                             |                      |  |  |                                                               |  |  |                         |
|                                   |         |                   |             |              |             |                             |          |       |                                                          |                | 2.           |                             |                      |  |  |                                                               |  |  |                         |
| — 20,09                           | 1       | γ Pegasi          | 0 4 8,09    | 75 48 0,11   | 75 48 2,4   | 2,3                         | 14       | 25    | 13                                                       | 76 49 41,7     | 38           |                             |                      |  |  |                                                               |  |  |                         |
| — 19,85                           | 2       | α Cassiopeiaē     | 0 30 31,29  | 34 26 4,23   | 34 26 5,7   | 1,5                         | 5        | 77    | 19                                                       | 34 27 44,3     | 136          |                             |                      |  |  |                                                               |  |  |                         |
|                                   | 3       | Polaris*          | 0 57 46,4   |              | 1 38 7,5    |                             |          | 200   | 300                                                      | 1 39 44,5      | 500          |                             |                      |  |  |                                                               |  |  |                         |
| — 17,40                           | 4       | α Arietis         | 1 57 13,09  | 67 22 42,60  | 67 22 44,4  | 1,8                         | 10       | 77    | 91                                                       | 67 24 10,6     | 168          |                             |                      |  |  |                                                               |  |  |                         |
| — 14,59                           | 5       | α Ceti            | 2 53 2,29   | 46 36 34,86  | 86 36 36,8  | 2,0                         | 7        | 18    | 31                                                       | 86 37 48,7     | 49           |                             |                      |  |  |                                                               |  |  |                         |
| — 13,41                           | 6       | α Persei          | 3 11 44,48  | 40 46 38,34  | 40 46 39,0  | 0,7                         | 10       | 66    | 48                                                       | 40 47 45,7     | 114          |                             |                      |  |  |                                                               |  |  |                         |
| — 7,92                            | 7       | Aldebaran         | 4 25 46,58  | 73 51 16,17  | 73 51 17,7  | 1,5                         | 60       | 69    | 74                                                       | 73 51 56,4     | 143          |                             |                      |  |  |                                                               |  |  |                         |
| — 4,54                            | 8       | Capella           | 5 3 37,83   | 44 11 35,11  | 44 11 36,9  | 1,8                         | 59       | 108   | 95                                                       | 44 11 58,8     | 203          |                             |                      |  |  |                                                               |  |  |                         |
| — 4,74                            | 9       | Rigel             | 5 6 2,21    | 98 24 46,44  | 98 24 48,4  | 2,0                         | 37       | 30    | 11                                                       | 98 25 11,2     | 41           |                             |                      |  |  |                                                               |  |  |                         |
| — 3,80                            | 10      | β Tauri           | 5 15 6,76   | 61 33 5,74   | 61 33 6,7   | 1,0                         | 14       | 70    | 66                                                       | 61 33 25,0     | 136          |                             |                      |  |  |                                                               |  |  |                         |
| — 1,36                            | 11      | α Orionis         | 5 45 35,66  | 82 38 2,11   | 82 38 4,2   | 2,1                         | 69       | 66    | 62                                                       | 82 38 9,9      | 128          |                             |                      |  |  |                                                               |  |  |                         |
| +                                 | 4,41    | 12 Sirius         | 6 37 20,85  | 106 28 45,35 | 106 28 48,7 | 3,4                         | 84       | 30    | 82                                                       | 106 28 25,1    | 112          |                             |                      |  |  |                                                               |  |  |                         |
| +                                 | 7,12    | 13 Castor         | 7 23 17,62  | 57 43 58,08  | 57 43 59,1  | 1,0                         | 19       | 47    | 78                                                       | 57 43 23,0     | 125          |                             |                      |  |  |                                                               |  |  |                         |
| +                                 | 8,63    | 14 Procyon        | 7 30 2,19   | 84 19 40,75  | 84 19 43,2  | 2,4                         | 64       | 40    | 64                                                       | 84 18 58,9     | 104          |                             |                      |  |  |                                                               |  |  |                         |
| +                                 | 8,02    | 15 Pollux         | 7 34 28,52  | 61 33 16,76  | 61 33 17,1  | 0,3                         | 38       | 53    | 75                                                       | 61 32 36,8     | 128          |                             |                      |  |  |                                                               |  |  |                         |
| +                                 | 15,19   | α Hydræ           | 9 18 53,50  | 97 53 43,20  | 97 53 44,5  | 1,3                         | 5        | 10    | 30                                                       | 97 52 27,9     | 40           |                             |                      |  |  |                                                               |  |  |                         |
| +                                 | 17,23   | 17 Regulus        | 9 58 56,36  | 77 10 15,00  | 77 10 15,4  | 0,4                         | 25       | 68    | 79                                                       | 77 8 49,2      | 147          |                             |                      |  |  |                                                               |  |  |                         |
| +                                 | 19,26   | α Ursæ Maj.       | 10 52 43,41 | 27 17 44,16  | 27 17 43,6  | — 0,6                       | 7        | 76    | 80                                                       | 27 16 7,6      | 150          |                             |                      |  |  |                                                               |  |  |                         |
| +                                 | 20,04   | β Leonis          | 11 40 1,66  | 74 26 17,73  | 74 26 18,1  | 0,4                         | 11       | 22    | 32                                                       | 74 24 37,7     | 54           |                             |                      |  |  |                                                               |  |  |                         |
| +                                 | 19,98   | γ Ursæ Maj.       | 11 44 28,63 | 35 19 15,18  | 35 19 14,8  | — 0,4                       | 5        | 60    | 45                                                       | 35 17 34,9     | 105          |                             |                      |  |  |                                                               |  |  |                         |
| +                                 | 18,94   | 21 Spica Virg.    | 13 15 52,91 | 100 14 0,73  | 100 14 0,7  | 0,0                         | 19       | 20    | 46                                                       | 100 12 26,0    | 66           |                             |                      |  |  |                                                               |  |  |                         |
| +                                 | 18,15   | η Ursæ Maj.       | 13 40 33,54 | 39 47 59,60  | 39 47 59,5  | — 0,1                       | Z. Sect. | 100   | 95                                                       | 39 46 28,9     | 195          |                             |                      |  |  |                                                               |  |  |                         |
| +                                 | 18,97   | Arcturus          | 14 7 35,61  | 69 53 28,83  | 69 53 29,2  | 0,4                         | 106      | 120   | 106                                                      | 69 51 54,1     | 226          |                             |                      |  |  |                                                               |  |  |                         |
| +                                 | 15,30   | 1 } α Libræ {     | 14 40 54,93 | 105 15 11,91 | 105 15 12,5 | } 0,6                       | 4        | 12    | 14                                                       | 105 13 56,8    | 26           |                             |                      |  |  |                                                               |  |  |                         |
| +                                 | 15,32   | 2 }               | 14 41 6,36  | 105 17 55,67 | 105 17 56,3 |                             | 11       | 15    | 20                                                       | 103 16 39,5    | 35           |                             |                      |  |  |                                                               |  |  |                         |
| +                                 | 14,74   | β Ursæ Min.       | 14 51 19,53 | 15 7 16,38   | 15 7 15,6   | — 0,8                       | 1        | 110   | 109                                                      | 15 6 2,3       | 219          |                             |                      |  |  |                                                               |  |  |                         |
| +                                 | 12,45   | 27 α Cor. Bor.    | 15 27 11,95 | 62 41 0,07   | 62 41 0,6   | 0,5                         | 7        | 90    | 42                                                       | 62 39 58,1     | 132          |                             |                      |  |  |                                                               |  |  |                         |
| +                                 | 11,72   | 28 α Serpēntis    | 15 35 33,53 | 83 0 36,52   | 83 0 36,6   | 0,1                         | 5        | 77    | 45                                                       | 82 59 38,0     | 122          |                             |                      |  |  |                                                               |  |  |                         |
| +                                 | 8,59    | 29 Antares        | 16 18 34,23 | 106 1 42,50  | 116 1 44,1  | 1,6                         | 21       | 36    | 10                                                       | 116 1 0,1      | 46           |                             |                      |  |  |                                                               |  |  |                         |
| +                                 | 4,57    | 30 α Herculis     | 17 6 35,00  | 75 23 59,70  | 75 24 0,1   | 0,4                         | 7        | 55    | 30                                                       | 75 23 37,0     | 85           |                             |                      |  |  |                                                               |  |  |                         |
| +                                 | 3,08    | 31 α Ophiuchi     | 17 26 43,49 | 77 18 9,74   | 77 18 10,6  | 0,9                         | 3        | 83    | 32                                                       | 77 17 54,7     | 115          |                             |                      |  |  |                                                               |  |  |                         |
| +                                 | 0,67    | 32 γ Draconis     | 17 52 30,14 | 38 29 10,31  | 38 29 10,5  | 0,2                         | Z. Sect. | 140   | 120                                                      | 38 29 7,1      | 260          |                             |                      |  |  |                                                               |  |  |                         |
| —                                 | 3,02    | 33 α Lyræ         | 18 30 56,98 | 51 22 30,37  | 51 22 31,2  | 0,8                         | 89       | 170   | 147                                                      | 51 22 45,9     | 317          |                             |                      |  |  |                                                               |  |  |                         |
| —                                 | 8,34    | 34 γ }            | 19 37 50,82 | 79 48 35,58  |             | } 1,0                       | 6        | 35    | 22                                                       | 103 3 42,5     | 57           |                             |                      |  |  |                                                               |  |  |                         |
| —                                 | 9,06    | 35 α } Aquilæ {   | 19 42 8,94  | 81 35 28,31  | 81 35 29,5  |                             |          |       |                                                          |                |              |                             |                      |  |  |                                                               |  |  |                         |
| —                                 | 8,56    | 36 β }            | 19 46 37,27 | 84 1 37,94   |             |                             |          |       |                                                          |                |              |                             |                      |  |  |                                                               |  |  |                         |
| —                                 | 10,66   | 37 1 } α Capri. { | 20 7 49,91  | 103 2 48,83  | 103 2 49,6  | } 1,0                       | 10       | 28    | 22                                                       | 103 5 59,4     | 50           |                             |                      |  |  |                                                               |  |  |                         |
| —                                 | 10,68   | 38 2 }            | 20 8 13,69  | 103 5 5,45   | 103 5 6,6   |                             |          |       |                                                          |                |              |                             |                      |  |  |                                                               |  |  |                         |
| —                                 | 12,63   | 39 α Cygni        | 20 35 24,19 | 45 20 50,80  | 45 20 52,4  | 1,6                         | 55       | 120   | 120                                                      | 45 21 54,5     | 240          |                             |                      |  |  |                                                               |  |  |                         |
| —                                 | 15,07   | 40 α }            | 21 14 21,05 | 28 9 42,20   | 28 9 42,8   | 0,6                         | 5        | 70    | 50                                                       | 28 10 57,7     | 127          |                             |                      |  |  |                                                               |  |  |                         |
| —                                 | 15,68   | 41 β }            | 21 26 20,44 | 20 12 53,78  | 20 12 54,0  | 0,2                         | 5        | 70    | 62                                                       | 20 14 12,5     | 132          |                             |                      |  |  |                                                               |  |  |                         |
| —                                 | 17,27   | 42 α Aquarii      | 21 56 41,55 | 91 10 28,85  | 91 10 31,4  | 2,5                         | 9        | 20    | 55                                                       | 91 11 56,4     | 75           |                             |                      |  |  |                                                               |  |  |                         |
|                                   | 43      | Fomalhaut         | 22 47 50,97 |              |             |                             |          |       |                                                          |                |              |                             |                      |  |  |                                                               |  |  |                         |
| —                                 | 19,32   | 44 α Pegasi       | 22 55 57,20 | 75 44 38,52  | 75 44 41,8  | 3,3                         | 6        | 30    | 50                                                       | 75 46 16,7     | 80           |                             |                      |  |  |                                                               |  |  |                         |
| —                                 | 19,95   | 45 α Andromedæ.   | 23 59 15,61 | 61 53 10,75  | 61 53 12,5  | 1,8                         | 11       | 40    | 40                                                       | 61 54 51,4     | 80           |                             |                      |  |  |                                                               |  |  |                         |

\* The mean of about 1300 observations of the pole star during the last ten years, is 1° 39' 44",5 for the N. P. D. for Jan. 1, 1818, and the mean of all the annual variations 19",42 or 19",43.

TABLE IX.  
Observations of  $\alpha$  Lyrae.

Two Microscopes.

| Summer.                              |         |             | Autumn.                              |         |             | Winter.                              |         |             |
|--------------------------------------|---------|-------------|--------------------------------------|---------|-------------|--------------------------------------|---------|-------------|
| 1822.                                | Direct. | Reflection. | 1822.                                | Direct. | Reflection. | 1822.                                | Direct. | Reflection. |
| July 3                               | 32,82   | 7,94        | Aug. 29                              | 34,41   | 7,37        | Nov. 3                               | 36,05   | 9,15        |
| 4                                    | 34,64   | 8,64        | Sept. 3                              | 34,53   | 7,19        | 4                                    | 35,64   | 8,58        |
| 10                                   | 34,88   | 8,51        | 6                                    | 34,32   | 7,59        | 11                                   | 34,63   | 9,74        |
| 17                                   | 34,92   | 6,59        | 19                                   | 35,13   | 7,12        | 13                                   | 35,68   | 8,70        |
| 20                                   | 34,38   | 8,25        | 8                                    | 34,35   | 7,55        | 15                                   | 34,52   | 7,89        |
| 21                                   | 35,28   | 7,73        | 11                                   | 32,75   | 7,12        | 18                                   | 36,07   | 8,43        |
| 24                                   | 34,94   | 8,63        | 14                                   | 33,87   | 9,02        | 20                                   | 36,28   | 8,88        |
| 25                                   | 34,09   | 8,05        | 16                                   | 34,39   | 7,44        | 23                                   | 35,81   | 9,02        |
| 28                                   | 35,15   | 8,55        | 18                                   | 34,76   | 10,24       | Dec. 5                               | 33,79   | 10,26       |
| 30                                   | 34,39   | 9,11        | 28                                   | 35,15   | 8,73        | 8                                    | 34,77   | 9,07        |
| Aug. 4                               | 33,36   | 8,26        | 30                                   | 35,37   | 9,00        | 10                                   | 35,09   | 1823.       |
| 8                                    | 34,80   | 9,96        | Oct. 5                               | 36,59   | 9,52        | 11                                   | 35,82   | Jan. 8      |
| 10                                   | 35,82   | 9,81        | 6                                    | 34,79   | 8,30        | 21                                   | 35,50   | 8,83        |
| 13                                   | 34,79   | 8,07        | 7                                    | 34,86   | 7,03        | 22                                   | 33,90   | 6,94        |
| 15                                   | 34,40   | 8,26        | 12                                   | 34,49   | 8,84        | 26                                   | 33,84   | 7,22        |
| 17                                   | 33,70   | 8,04        | 21                                   | 34,23   | 7,70        | 1823.                                |         | 8,84        |
| 19                                   | 35,68   | 7,18        | 23                                   | 36,57   | 8,43        | Jan. 18                              | 35,83   | 8,57        |
| 22                                   | 35,88   |             | 26                                   | 34,50   | 9,00        | Feb. 3                               | 35,15   | 6,75        |
| 27                                   | 35,07   |             | 28                                   | 35,31   |             | 4                                    | 35,06   | 8,71        |
|                                      |         |             |                                      |         |             | 13                                   | 34,46   | 8,85        |
|                                      |         |             |                                      |         |             | 23                                   | 35,28   | 7,95        |
| Mean of 19 = 34,63                   |         |             | Mean of 17 = 8,45                    |         |             | Mean of 20 = 35,16                   |         |             |
| $\frac{R-D}{2} = 16,91$ of altitude. |         |             | $\frac{R-D}{2} = 16,74$ of altitude. |         |             | $\frac{R-D}{2} = 16,67$ of altitude. |         |             |

TABLE X.  
Observations of  $\alpha$  Lyrae.  
Six Microscopes.

| Summer.                              |         |             | Autumn.                              |         |             | Winter.                              |         |             |
|--------------------------------------|---------|-------------|--------------------------------------|---------|-------------|--------------------------------------|---------|-------------|
| 1822.                                | Direct. | Reflection. | 1822.                                | Direct. | Reflection. | 1822.                                | Direct. | Reflection. |
| July 3                               | 33.42   | 8.54        | Aug. 29                              | 34.71   | 8.27        | Nov. 3                               | 34.63   | 8.13        |
| 4                                    | 34.84   | 8.94        | Sept. 3                              | 35.13   | 7.99        | 4                                    | 34.42   | 8.26        |
| 10                                   | 34.28   | 8.31        | 4                                    | 35.12   | 8.29        | 11                                   | 34.21   | 9.54        |
| 17                                   | 34.32   | 7.29        | 6                                    | 35.36   | 8.29        | 13                                   | 34.46   | 9.60        |
| 20                                   | 34.32   | 7.35        | 8                                    | 34.85   | 7.37        | 15                                   | 33.30   | 8.69        |
| 21                                   | 34.58   | 8.13        | 11                                   | 32.35   | 7.95        | 18                                   | 34.35   | 8.73        |
| 24                                   | 34.68   | 8.53        | 14                                   | 34.17   | 8.52        | 20                                   | 34.76   | 8.68        |
| 25                                   | 33.94   | 8.85        | 16                                   | 33.69   | 7.14        | 23                                   | 34.49   | 8.67        |
| 28                                   | 33.99   | 8.85        | 18                                   | 34.86   | 9.34        | Dec. 5                               | 33.69   | 10.31       |
| 30                                   | 34.45   | 8.85        | 28                                   | 33.85   | 8.33        | 8                                    | 34.57   | 9.22        |
| Aug. 4                               | 33.26   | 8.39        | 30                                   | 34.47   | 8.79        | 10                                   | 34.69   | 1823.       |
| 8                                    | 34.45   | 8.86        | Oct. 5                               | 35.08   | 9.61        | 11                                   | 35.72   | 8.55        |
| 10                                   | 35.82   | 9.81        | 6                                    | 35.68   | 8.41        | 21                                   | 35.35   | 8.85        |
| 13                                   | 34.79   | 7.76        | 7                                    | 34.75   | 7.42        | 22                                   | 33.65   | 7.96        |
| 15                                   | 34.40   | 8.06        | 12                                   | 35.09   | 8.63        | 26                                   | 35.31   | 7.27        |
| 17                                   | 33.48   | 7.64        | 21                                   | 35.12   | 8.29        | 1823.                                |         | 7.70        |
| 19                                   | 35.88   | 8.08        | 23                                   | 34.30   | 8.51        | Jan. 18                              | 34.30   | 8.12        |
| 22                                   | 34.98   |             | 26                                   | 33.68   | 8.08        | Feb. 3                               | 34.32   | 7.60        |
| 27                                   | 34.47   |             | 28                                   | 33.89   |             | 4                                    | 34.64   | 8.76        |
|                                      |         |             |                                      |         |             | 13                                   | 34.35   | 8.00        |
|                                      |         |             |                                      |         |             | 23                                   | 34.55   | 8.09        |
|                                      |         |             |                                      |         |             |                                      |         |             |
| Mean of 19 = 34.39                   |         |             | Mean of 17 = 8.41                    |         |             | Mean of 20 = 34.49                   |         |             |
| $\frac{R-D}{2} = 17.01$ of altitude. |         |             | $\frac{R-D}{2} = 16.88$ of altitude. |         |             | $\frac{R-D}{2} = 17.02$ of altitude. |         |             |

| TABLE XI.                                                                   |        |                                   |   |   |                               |    |   |   |   |             |
|-----------------------------------------------------------------------------|--------|-----------------------------------|---|---|-------------------------------|----|---|---|---|-------------|
| <i><math>\alpha</math> Lyræ compared with <math>\gamma</math> Draconis.</i> |        |                                   |   |   |                               |    |   |   |   |             |
|                                                                             |        | No. of Obs.<br>$\gamma$ Draconis. |   |   | No. of Obs.<br>$\alpha$ Lyræ. |    |   |   |   | ° / "       |
| 1812                                                                        | Summer | 30                                | - | - | -                             | 24 | - | - | - | 12 53 56,77 |
| 1813                                                                        | Summer | 36                                | - | - | -                             | 40 | - | - | - | 12 53 56,77 |
| Mean of 2 years                                                             |        |                                   |   |   |                               | -  | - | - | - | 12 53 56,77 |
| 1812                                                                        | Winter | 16                                | - | - | -                             | 23 | - | - | - | 12 53 57,02 |
| 1813                                                                        | Winter | 15                                | - | - | -                             | 30 | - | - | - | 12 53 56,80 |
| Mean of 2 years                                                             |        |                                   |   |   |                               | -  | - | - | - | 12 53 56,91 |
| Double Parallax of $\alpha$ Lyræ                                            |        |                                   |   |   |                               | -  | - | - | - | 0,14        |
| 1822                                                                        | Winter | 24                                | - | - | -                             | 30 | - | - | + | 12 53 24,7  |
| 1822                                                                        | Summer | 50                                | - | - | -                             | 25 | - | - | - | 12 53 24,7  |
| 1823                                                                        | Winter | 40                                | - | - | -                             | 27 | - | - | - | 12 53 24,7  |
| Double Parallax of $\alpha$ Lyræ                                            |        |                                   |   |   |                               | -  | - | - | - | 0,0         |

*Explanation of the preceding Tables.*

TABLE I. The predicted catalogue in this table is obtained from the Greenwich Catalogues of 1756 and 1813: all the computations will be found at length in the volume of the Greenwich Observations for 1820. The five groupes of stars in the last column are those referred to in page 42.

TABLE II. is the same catalogue arranged in the order of right ascension.

TABLE III. is an interpolated catalogue: it was computed some time since from a catalogue less perfect than the present, but it is sufficiently exact to show that no explanation of the difficulty can be obtained by supposing any defect in the observations of 1813. The numbers in this table under the columns Dublin and

Greenwich, are the quantities that must be applied to the Dublin and Greenwich observations to produce the interpolated catalogue.

TABLE IV. contains four catalogues, in which, as no systematic difference can be traced, the instrument must be considered as perfect within the limits of the small discordances in Catalogue I. and II.

TABLE V. contains the errors of each of the preceding catalogues. From this table it appears, that the regular difference between the results with six and with two microscopes, is now nearly insensible. This must have arisen formerly from flexure; and the new braces, though intended only to strengthen the attachment of the telescope to the circle, have, in fact, added strength and firmness to the whole frame of the instrument. (Vide Experiments on this subject in the volume of Observations for 1820.)

TABLE VI. shows the difference between the results of the Dublin and Greenwich circle, both at the present time, and in the year 1812. From this it is evident that a small change has taken place in one of the instruments. Formerly the two instruments differed only one second in an arc of  $90^\circ$ ; at present, the difference amounts very exactly to double that quantity.

TABLE VII. contains the two catalogues of Dr. BRINKLEY and Mr. BESSEL. Here the differences are much greater and more irregular.

TABLE VIII. contains a general catalogue of the stars, including several that were not very accurately observed in 1813; but which, nevertheless, confirm in a remarkable manner the general law of southern deviation.

TABLES IX, X and XI. contain observations of  $\alpha$  Lyræ, by which it appears, that whatever may be the parallax of this star, it is not within the powers of our instrument to detect it. With Dr. BRINKLEY's Refraction, the result would have been a very small fraction of a second less in favour of parallax.